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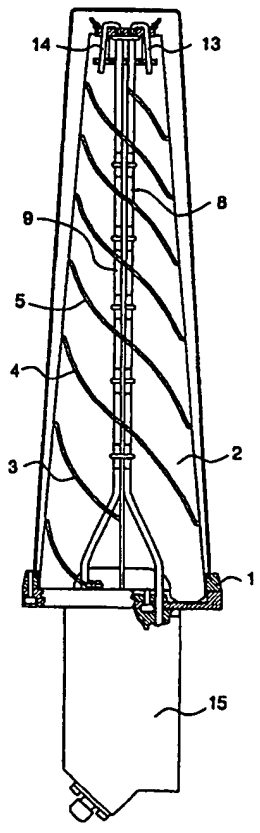
(54) Title: ANTENNA ELEMENT, CONICALLY HELICAL, FOR POLARIZATION PURITY WITHIN A BROAD FREQUENCY RANGE

(57) Abstract

An antenna element is described. It comprises a ground plane (1) and a conical support (2) of a dielectric that with its bottom portion is attached to the plane and supports first to fourth radiation means having the shape of helical wires (3-6) which are symmetrically arranged around and are carried by the support. The radiation means are attached to the ground plane at their exterior lower ends and for transmission they are provided with a microwave signal each at their upper interior portions through a coaxial cable (8, 9) each, so that two orthogonal, preferably circular polarizations are generated by the emitted radiation. The antenna element is particularly characterized by a distribution network (15) arranged to divide, for transmission, the incoming signal in four subsignals which are offset in phase in relation to each other, each one of which being provided to a corresponding one of said first to fourth radiation means (3-6), and that adaption means (14) are arranged to adapt the output impedance of the distribution network to the input impedance of the radiation means so that it is substantially independent of the actual microwave frequency used within a relatively wide frequency range.



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ANTENNA ELEMENT, CONICALLY HELICAL, FOR POLARIZATION PURITY WITHIN A BROAD FREQUENCY RANGE

The present invention relates to an antenna element comprising a ground plane and a conical support of a dielectric material, which with its bottom portion is attached to the plane and supports first to fourth radiation means having the shape of helical wires that are arranged symmetrically around and are carried by the support, the radiation means being at their exterior, lower ends attached to the ground plane and for transmission each one being provided, at their upper, interior parts, through an individual coaxial cable with an individual microwave signal, so that two orthogonal polarisations that preferably are circular are generated by the emitted radiation.

Such antenna elements are used particularly in group antennas for satellites. Requirements are made that such antennas should have a good polarization purity, i.e. that a low amount of radiation of the non-desired polarization must be obtained and a high amount of radiation having the desired polarization. At the same time there is a need for broadband properties, i.e. that the antenna will be able to emit and receive microwave signals within a relatively wide frequency range. If the frequency range would be limited to one or more narrow bands, the polarization purity itself can be improved but thus only at the sacrifice of the broadband characteristics.

The purpose of the present invention is to provide an antenna element of the kind mentioned in the introduction, which thus permits both a high polarization purity and broad band properties. According to the invention such an antenna element is primarily characterized in that for transmission a distribution network is arranged to divide the incoming signal into four subsignals that are offset in phase in relation to each other and that each one is provided to one of the first to fourth radiation means mentioned above, and that adaption means are arranged to adapt the output impedance of the distribution network to the input impedance of the radiation means, so that it is substantially independent of the actual microwave frequency used within a relatively wide frequency range.

In an advantageous embodiment of the antenna element according to the invention the adaption means comprise four separate conductors that constitute capacitive loads which with their ends are connected to the upper ends of a corresponding radiation means.

In an alternative embodiment the adaption means comprises a metal block constructed to include four interior channels through which the respective conductor in said coaxial cables extend substantially centrally.

The invention will be described in the following in greater detail with reference to the accompanying schematic drawings in which:

Fig. 1A shows an elevational view which partially is a sectional view of an antenna element according to the invention,
Fig. 1B shows the antenna element of Fig. 1A as seen from above,
Fig. 2A shows an elevational view which partially is a sectional view of an adaption means,
Fig. 2B shows the adaption means of Fig. 2A as seen from above,
Fig. 3A shows an elevational view which partially is a sectional view of an alternative adaption means,
Fig. 3B shows the adaption means of Fig. 3A as seen from above,
Fig. 4 shows the input impedance Z of the radiation means as a function of the frequency in GHz for an older antenna element, graph I, and an antenna element according to the invention, graph II.

In Figs. 1A and 1B a ground plane having the shape of a circular metal plate has the reference numeral 1. A conical support 2 of a dielectric material is with its bottom portion attached to the ground plane. The support is constructed from two planes arranged orthogonally in relation to each other and carries at its geometric envelope surface first to fourth radiation means having the shape of helical wires 3 to 6 that are arranged symmetrically around the support. Four coaxial cables, two cables thereof having the reference numerals 8, 9 being shown in Fig. 1A, extend up through the centre of the support, and the conductors in these coaxial cables that are referenced 7 - 10 are at their top portions joined to one helical wire 3 - 6 each. The latter ones are at their bottom portions joined to the ground plane 1. The lobes of the antennas can be varied by changing the conical apex angle of the support and the angular pitch of the helical wires.

In this embodiment of the antenna element according to the invention adaption means having the shape of four separate conductors 11 to 14 are directly connected to, i.e. by being soldered to, an end of an above mentioned conductor 7 - 10 each, before the connection thereof to the respective radiation means. These separate conductors 11 - 14 are thus constituted of short metal wires having their non-

connected ends free so that they constitute capacitive loads.

The antenna signal is fed through a distribution network 15, not shown in detail, and is divided in four signals having the same amplitude but having their phases distributed at the angular values of 0°, 90°, 180°, and 270°, these signals being delivered to the four coaxial cables.

The distribution network, the adaption means and the radiation means are now so arranged that a high polarization purity is obtained within a wide frequency range. If the elevational lobe of the antenna element is maintained constant and is varied azimuthally a minimal variation of the radiation of the desired polarization, that can be linear or elliptical, in particular circular, is obtained.

It is possible to use the adaption means shown in Figs. 1A and 1B e.g. within the frequency range of 2.0 to 2.3 GHz. In Fig. 3 a comparison is shown of the input impedance Z of the radiation means for an older design of an antenna element of the kind mentioned in the introduction, by the graph I and the corresponding graph II for an antenna element according to the invention. It is apparent that the impedance is relatively independent of the frequency of the antenna element according to the invention.

An alternative embodiment of the adaption means having the shape of an adaption transformer is shown in Figs. 2A and 2B. It consists of a metal block 16 having four interior channels 17, through which the respective conductor 18 of said coaxial cables 8, 9 extend substantially centrally, having distance washers of a dielectric material. This adaption means is placed at the top of the antenna element, close to the connection to the radiation means, and is suited for use e.g. within the frequency range of 1.2 to 1.6 GHz.

A variant the last mentioned embodiment of the invention that is seen from Figs. 3A and 3B comprises that the adaption means consists of four metal blocks 19, that each one is designed to have an interior channel 20, through each one of which one of the four conductors 21 in said coaxial cables 8, 9 extend substantially centrally. The four metal blocks 19 which are similar to each other are arranged, as seen in a cross sectional view according to Fig. 3B, in a square pattern at some distance from each other.

Claims

1. An antenna element comprising a ground plane (1) and a conical support (2) of a dielectric material, which with its bottom portion is attached to the plane and supports first to fourth radiation means having the shape of helical wires (3 - 6), that are symmetrically arranged around and supported by the support, the radiation means being attached to the ground plane at their exterior, lower ends and at their upper interior ends, for transmission, are provided with an individual microwave signal through an individual coaxial cable (8, 9), so that two orthogonal polarizations, preferably circular, are generated by the emitted radiation,
characterized in,
that a distribution network (15) is arranged for dividing the signal incoming for transmission in four subsignals which are offset in phase in relation to each other and which each one is provided to said first to fourth radiation means (3 - 6) and that adaption means (11 - 14, 16) are arranged to adapt the output impedance of the distribution network to the input impedance of the radiation means, so that it is substantially independent of the actual microwave frequency used within a relatively wide frequency range and so that the amplitude of one of the polarizations to a high extent dominates the amplitude of the other polarization.

2. An antenna element according to claim 1,
characterized in
that the adaption means comprises four separate conductors (11 - 14), constituting capacitive loads that are attached with an end each to the upper end of a radiation means (3 - 6) each.

3. An antenna element according to claim 1,
characterized in
that the adaption means comprises a metal block (16) having four interior channels (17) through which respective conductors (18) in said coaxial cables (8, 9) extend substantially centrally.

4. An antenna element according to claim 1,
characterized in
that the adaption means comprises four metal blocks (19) that each one is provided with an interior channel (20), through each one of which one of the four conductors (21) in said coaxial cables (8, 9) extends substantially centrally.

Fig 1A

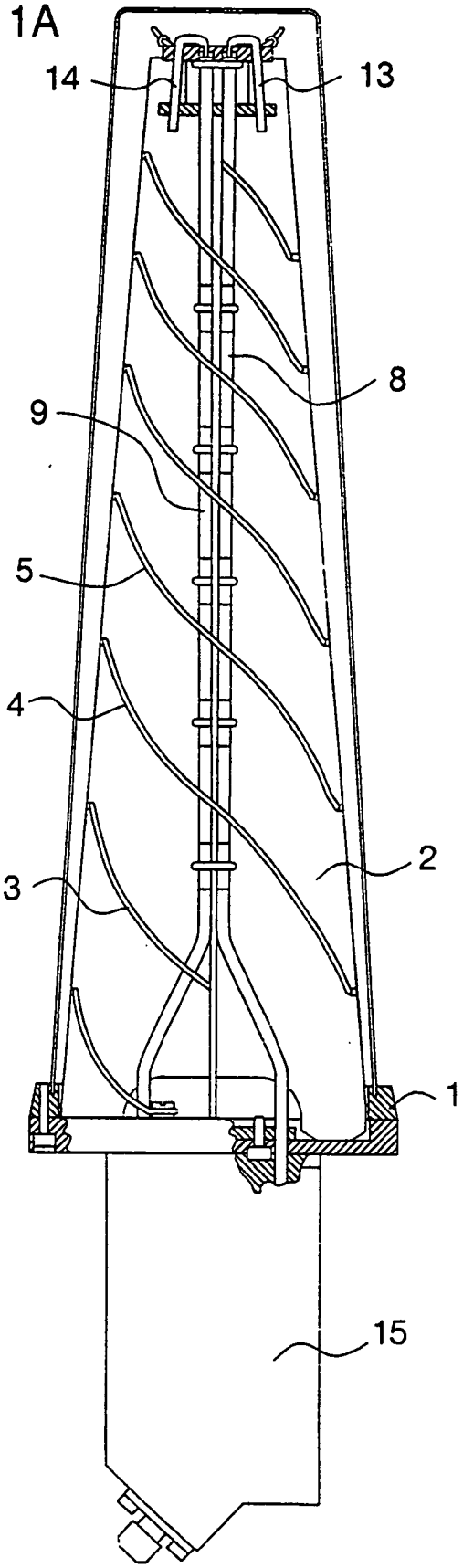


Fig 1B

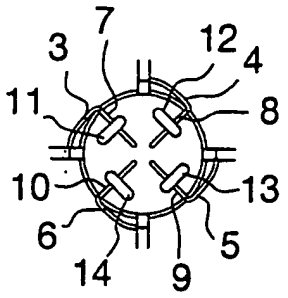


Fig 2A

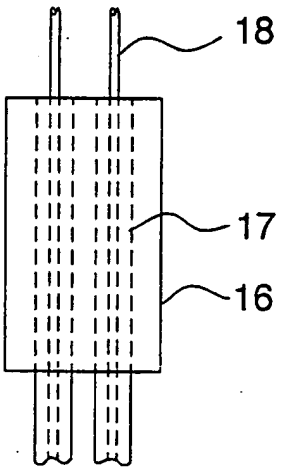


Fig 2B

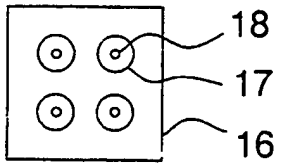


Fig 3A

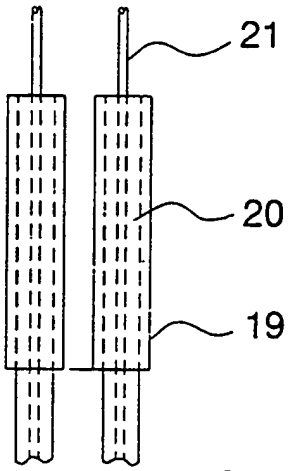
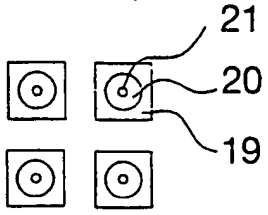


Fig 3B



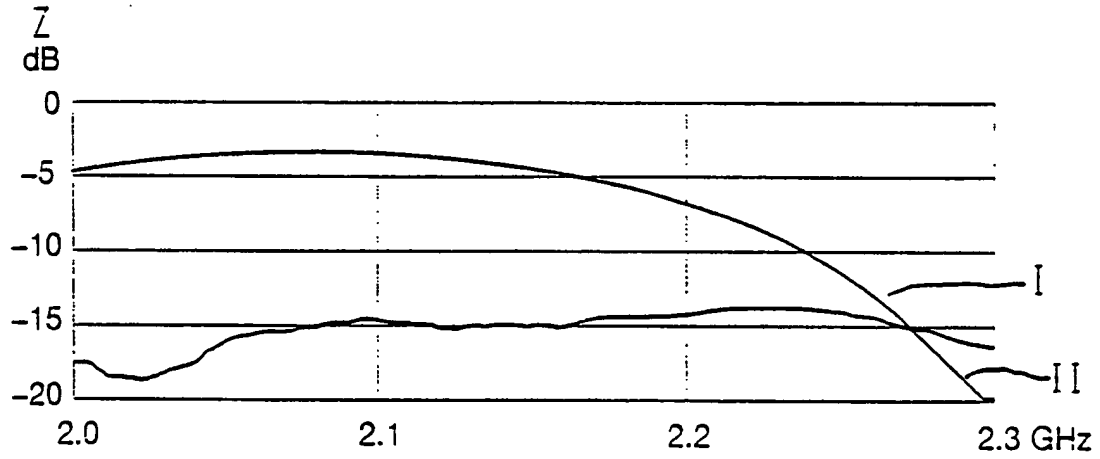


FIG 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00767

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01Q 11/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	EP 0465658 A1 (TOYO COMMUNICATION EQUIPMENT CO, LTD.), 15 January 1992 (15.01.92) --	1-2
X	US 3188643 A (J.D. DYSON ET AL), 8 June 1965 (08.06.65) --	1-2
A	WO 9421005 A1 (HER MAJESTY THE QUEEN IN RIGHT OF CANADA), 15 Sept 1994 (15.09.94) --	1-4

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A	US 5346300 A (H. YAMAMOTO ET AL), 13 Sept 1994 (13.09.94) -- --------	1-4

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31/07/96

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EP-A1- 0465658	15/01/92	AU-B- 643244	11/11/93
		AU-A- 6894591	05/08/91
		CA-A,C- 2047694	09/07/91
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		US-A- 5353040	04/10/94
		WO-A- 9111038	25/07/91
US-A- 3188643	08/06/65	NONE	
WO-A1- 9421005	15/09/94	AU-A- 5967594	26/09/94
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